Australian Government

Department of the Environment and Energy

National Inventory by Economic Sector 2017

Australia's National Greenhouse Accounts

June 2019

Contents

Part A – Direct Emissions (Scope 1 emissions)

Emissions at a Glance

The *National Inventory by Economic Sector* provides information on national emissions, disaggregated by Australia-New Zealand Standard Industry Classifications 2006 (ANZSIC). It complements the quarterly updates to the *National Greenhouse Gas Inventory* and the *State and Territory Greenhouse Gas Inventory*, which provide estimates of emissions classified according to Intergovernmental Panel on Climate Change (IPCC) process-based emission categories.

In 2017, the major emission sources were *electricity, gas and water* and *primary industries* (agriculture, forestry, fishing and mining), accounting for 38.4 per cent and 26.4 per cent of direct emissions respectively.

Table 1: Australia's Direct Greenhouse Gas Emissions by Economic Sector 2017[(a)][(b)]

Sector	Emissions (Mt CO_2-e)	Share of total emissions (per cent)
Primary Industries	**140.3**	**26.4**
Agriculture, Forestry and Fishing	59.6	11.2
Mining	80.7	15.2
Manufacturing	**53.7**	**10.1**
Electricity, Gas and Water	**204.1**	**38.4**
Services, Construction and Transport	**63.9**	**12.0**
Residential	**68.8**	**13.0**
All Sectors	530.8	100.0

Source: Australian Greenhouse Emissions Information System: http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

(a) Estimated using Kyoto Protocol classifications.

(b) Due to refinements to the emissions estimation methodologies, which have been applied to all years for which emissions have been estimated, the estimates presented in this document supersede all previously published estimates for the National Inventory by Economic Sector.

Trends in Direct Emissions

Emissions from the *electricity, gas and water* sector decreased between 2016 and 2017 (2.7 per cent or 5.6 Mt CO_2-e). This was primarily due to a decrease in emissions from brown coal and natural gas consumption. Emissions from the *agriculture, forestry and fishing* economic sector experienced a decrease in 2017 (3.3 per cent or 2.0 Mt CO_2-e) largely due to reduced net emissions from harvesting, fire and increased carbon sequestration activities. There was also a decline in emissions from the *manufacturing* sector (1.7 per cent or 0.9 Mt CO_2-e).

Emissions increased from the *residential* sector (0.6 per cent or 0.4 Mt CO_2-e), largely due to increased emissions from transport and synthetic gases used in refrigeration and air conditioning. The *mining* sector also increased (9.1 per cent or 6.8 Mt CO_2-e) between 2016 and 2017 due to expansions in liquefied natural gas exports.

Over the longer term, direct emissions have increased since 1990 in the *electricity, gas and water* (33.8 per cent or 51.6 Mt CO_2-e), *mining* (102.4 per cent or 40.8 Mt CO_2-e), *services, construction and transport* (105.7 per cent or 32.8 Mt CO_2-e), and *residential* (42.0 per cent or 20.4 Mt CO_2-e) sectors.

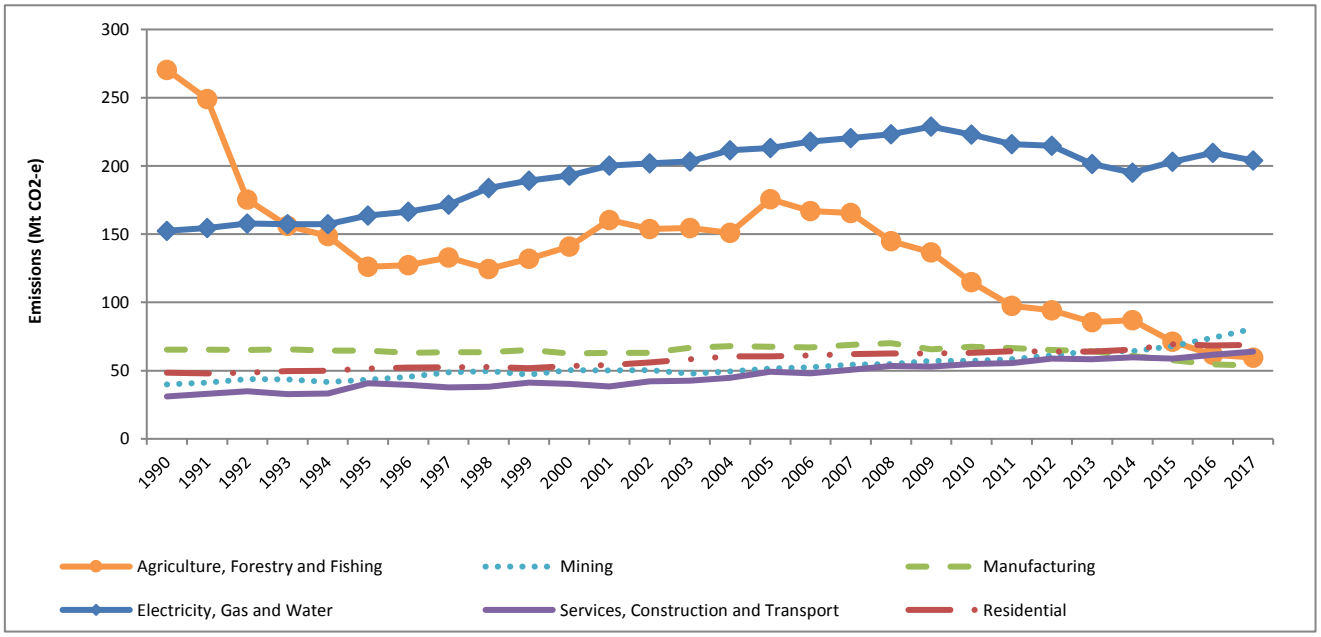
Emissions have declined since 1990 in the *agriculture, forestry and fishing* (78.0 per cent or 210.9 Mt CO_2-e) and *manufacturing* (17.9 per cent or 11.7 Mt CO_2-e) sectors. The strong decline in the *agriculture, forestry and fishing* sector reflects the impacts of declining emissions from the clearing of forest cover and harvesting of forests, and increased removals from *afforestation/reforestation* activities since 1990.

Table 2: Australia's Detailed Direct Greenhouse Gas Emissions Estimates by Economic Classification: 1990, 2016 and 2017

ANZSIC code	Industry Classification	Emissions (Mt CO_2-e)			Change in emissions (per cent)	
		1990	2016	2017	1990 to 2017	2016 to 2017
Div A	**Agriculture, forestry and fishing**	270.5	61.6	59.6	-78.0	-3.3
Div B	**Mining**	39.9	73.9	80.7	102.4	9.1
06	Coal mining	23.1	34.7	33.8	46.5	-2.7
07	Oil and gas extraction	14.3	31.3	38.6	169.8	23.2
08-10	Metal ore and non-metallic mineral mining and quarrying	2.5	7.9	8.3	232.6	5.3
Div C	**Manufacturing**	65.4	54.7	53.7	-17.9	-1.7
11-12	Food, beverages, tobacco	5.6	5.0	4.5	-20.2	-10.6
13	Textile, clothing, footwear and leather	0.5	0.4	0.4	-27.8	0.6
14-16	Wood, paper and printing	-1.4	-4.2	-4.6	236.6	10.8
17-19	Petroleum, coal and chemical	15.5	16.1	15.4	-0.9	-4.6
20	Non-metallic mineral products	9.8	9.4	9.2	-6.2	-1.5
21-22	Metal products	34.7	27.5	28.4	-18.3	3.2
24	Machinery and equipment	0.6	0.4	0.5	-23.3	8.8
25	Other manufacturing	0.0	0.1	0.1	312.9	-2.8
Div D	**Electricity, gas and water**	152.5	209.7	204.1	33.8	-2.7
Div E-H, J-Q	**Commercial services and construction**	17.5	30.6	31.5	80.0	2.8
Div I	**Transport and storage**	13.6	31.0	32.4	138.8	4.6
	Residential	48.5	68.4	68.8	42.0	0.6
	Residential (non transport)	9.1	15.7	15.8	74.4	0.5
	Residential (transport)	39.4	52.7	53.0	34.5	0.6
Total	All Sectors	607.8	529.9	530.8	-12.7	0.2

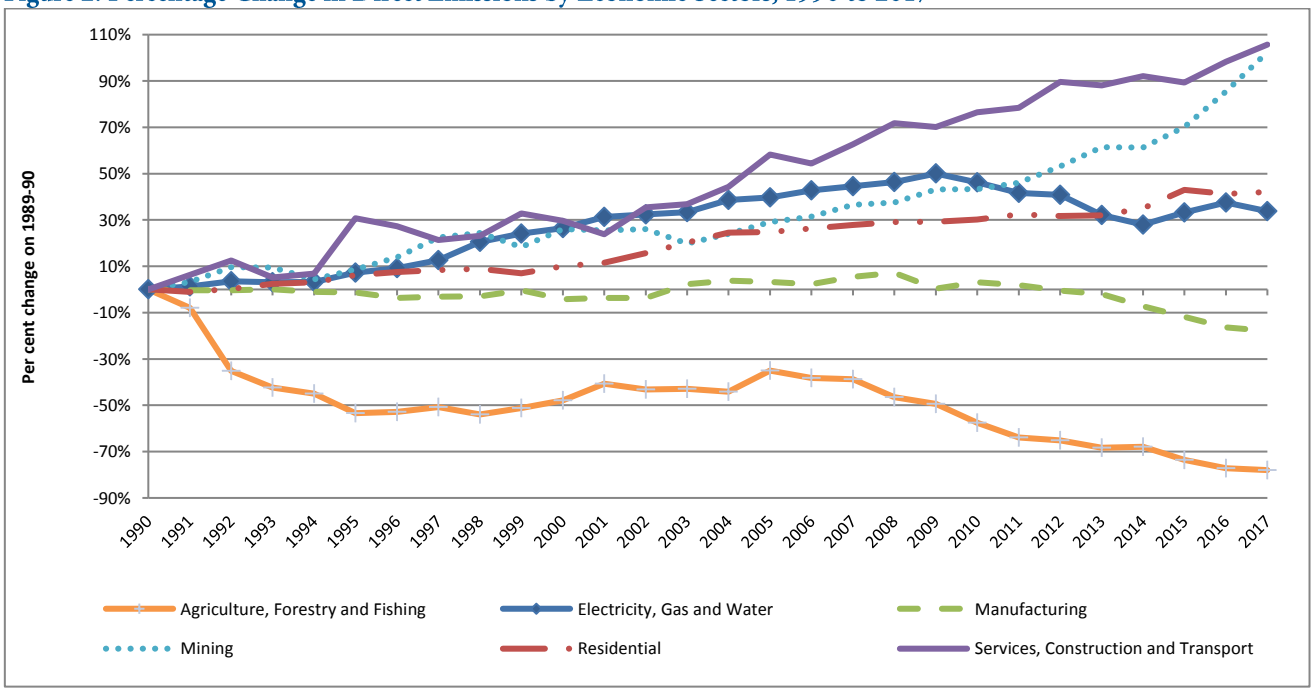
Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

Figure 1: Direct Emissions by Economic Sectors, 1990 to 2017



Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

Figure 2: Percentage Change in Direct Emissions by Economic Sectors, 1990 to 2017



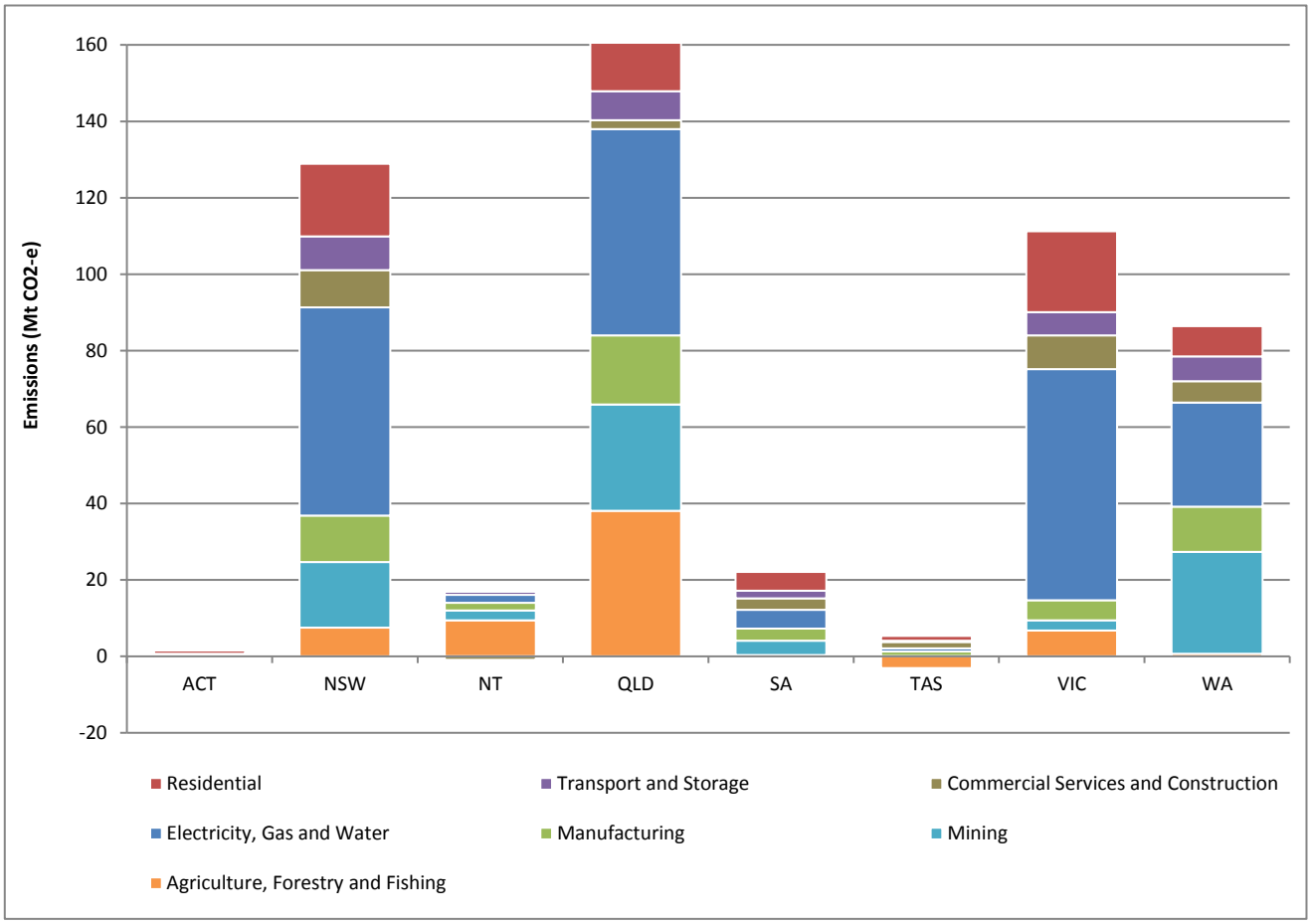
Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

State and Territory Direct Emissions by Economic Sector

The profile of emissions by economic sector in each state and territory reflect the diverse circumstances of individual states (see Table 4). For example, in 2017:

- The largest quantity of direct emissions from the *electricity, gas and water sector* was attributed to Victoria (60.5 Mt CO_2-e);
- The largest quantity of net emissions from the *agriculture, forestry and fishing* sector was attributed to Queensland (38.1 Mt CO_2-e);
- The largest quantity of direct emissions from the *mining* sector was attributed to Queensland (27.8 Mt CO_2-e); and
- The largest quantity of direct emissions from the *manufacturing* sector was attributed to Queensland (18.1 Mt CO_2-e).

Figure 3: Direct State and Territory Emissions by Economic Sector, 2017



Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

Table 3: State and Territory Emissions by Economic Classification, 1990

ANZSIC code	Industry Classification	NSW[a]	VIC	QLD	WA
		Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e
All Divisions	**Total Net Emissions**	**176.0**	**109.4**	**184.3**	**68.0**
Div A	Agriculture, forestry and fishing	54.0	22.7	129.3	31.4
Div B	Mining	19.9	3.7	4.1	6.3
Div C	Manufacturing	26.0	10.3	10.0	9.6
Div D	Electricity gas and water	53.7	50.1	26.1	12.2
Div E-H, J-Q	Commercial services and construction	4.3	4.0	4.6	2.0
Div I	Transport and storage	3.9	3.0	2.9	1.8
–	Residential	14.3	15.4	7.4	4.8

ANZSIC code	Industry Classification	SA	TAS	ACT (partial inventory)[a]	NT
		Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e
All Divisions	**Total Net Emissions**	**36.5**	**19.2**	**1.1**	**12.9**
Div A	Agriculture, forestry and fishing	11.7	13.5	-0.1	8.1
Div B	Mining	5.1	0.1	0.0	0.6
Div C	Manufacturing	5.1	2.3	0.0	2.2
Div D	Electricity gas and water	8.1	1.0	0.3	1.0
Div E-H, J-Q	Commercial services and construction	1.2	0.6	0.1	0.4
Div I	Transport and storage	1.3	0.3	0.1	0.2
–	Residential	4.1	1.4	0.7	0.4

Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

The NSW inventory includes ACT emissions from the stationary energy sector.
Notes: The difference between the national and the sum of the state and territory emissions reflects the inclusion of military transport and external territories in the national inventory and a small balancing item. Uncertainty estimates at a sectoral level are reported in the national inventory. While no quantitative estimates have been produced, the Department assesses that the uncertainties for emission estimates for the inventory, particularly the smaller states and territories, will be somewhat higher than for the national inventory.

Table 4: State and Territory Emissions by Economic Classification, 2017

ANZSIC code	Industry Classification	NSW[(a)]	VIC	QLD	WA
		Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e
All Divisions	**Total Net Emissions**	**128.9**	**111.2**	**161.2**	**86.4**
Div A	Agriculture, forestry and fishing	7.5	6.7	38.1	0.7
Div B	Mining	17.2	2.7	27.8	26.7
Div C	Manufacturing	12.2	5.3	18.1	11.8
Div D	Electricity gas and water	54.4	60.5	54.0	27.2
Div E-H, J-Q	Commercial services and construction	9.8	8.8	2.3	5.6
Div I	Transport and storage	8.8	6.1	7.7	6.5
–	Residential	19.0	21.2	13.3	7.9

ANZSIC code	Industry Classification	SA	TAS	ACT (partial inventory)[(a)]	NT
		Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e
All Divisions	**Total Net Emissions**	**22.1**	**2.3**	**1.3**	**16.5**
Div A	Agriculture, forestry and fishing	0.4	-3.0	-0.2	9.5
Div B	Mining	3.7	0.1	0.0	2.6
Div C	Manufacturing	3.2	1.2	-0.0	2.0
Div D	Electricity gas and water	4.9	0.8	0.2	2.1
Div E-H, J-Q	Commercial services and construction	3.0	1.7	0.3	-0.9
Div I	Transport and storage	1.9	0.4	0.2	0.8
–	Residential	4.9	1.2	0.9	0.5

Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

The NSW inventory includes ACT emissions from the stationary energy sector.
Notes: The difference between the national and the sum of the state and territory emissions reflects the inclusion of military transport and external territories in the national inventory and a small balancing item. Uncertainty estimates at a sectoral level are reported in the national inventory. While no quantitative estimates have been produced, the Department assesses that the uncertainties for emission estimates for the inventory, particularly the smaller states and territories, will be somewhat higher than for the national inventory.

Part B – Indirect Emissions from the Generation of Purchased Electricity (Scope 2 emissions)

Emissions from the generation of electricity have been allocated to electricity consumers according to the share of electricity consumption of each economic sector. These estimates are known as "indirect" emissions from the generation of purchased electricity, or scope 2 emissions. Scope 2 emissions are defined in the *National Greenhouse Accounts Factors* (*NGA Factors 2017*), based on the World Resources Institute and World Business Council for Sustainable Development (WRI-WBCSD), *The Greenhouse Gas Protocol: A corporate accounting and reporting standard (revised edition)*, 2004 (WRI/WBCSD 2004).

Indirect emissions provide an estimate of the contribution of emissions generated off site (in the electricity industry) as a result of economic activity in other sectors and reflects the interdependence of economic sectors across the Australian economy.

Table 5: Australia's Indirect Greenhouse Gas Emissions from the Generation of Purchased Electricity (Scope 2 Emissions) by Economic Sector, 1990 and 2017[(a)(b)(c)]

	Emissions ($Mt CO_2$-e)		Change in emissions (per cent)
	1990	2017	1990 – 2017
All Electricity Generation[(a)(d)]	129.6	189.8	46.5%
Primary Industries	9.2	20.5	122.3%
Agriculture, Forestry and Fishing	1.6	1.6	4.7%
Mining	7.7	18.9	146.2%
Manufacturing	42.3	48.9	15.7%
Commercial Services, Construction and Transport	24.6	50.7	106.1%
Residential	33.9	45.9	35.4%

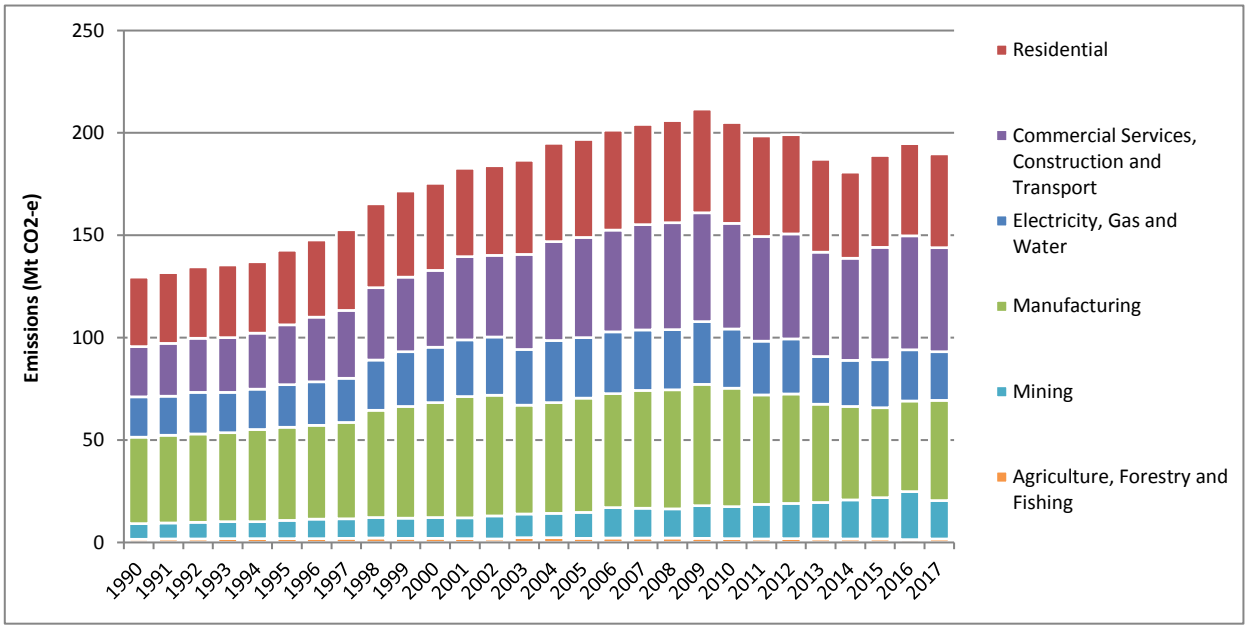
Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

(a) Scope 2 emissions account for greenhouse gas emissions from the generation of purchased electricity. Purchased electricity is definedas electricity that is purchased or otherwise brought into the organisational boundary of the entity (*NGA Factors 2017*).
(b) The estimate of scope 2 emissions from electricity generation consumed within the *electricity, gas and water* sector includes own use of electricity by generators and is not necessarily purchased electricity. As these emissions do not necessarily meet the definition outlined at dot point (a), they have been omitted from sectoral rows of the table above but included in the total. Electricity generation emissions attributed to the electricity, gas and water sector were 19.6 Mt CO_2-e in 1990 and 23.8 Mt CO_2-e in 2017.
(c) Sectoral emission totals do not sum to all electricity generation emissions as the *electricity, gas and water* sector is not included in theabove table as outlined at (b).

Trends in Indirect Greenhouse Gas Emissions from the Generation of Purchased Electricity (Scope 2 Emissions)

Emissions from electricity generation across all sectors have increased by 46.5per cent since 1990 (see Table 5). The largest driver of increased indirect emissions from the generation of purchased electricity is the *commercial services, construction and transport* sector, which has recorded an increase of 26.1 Mt CO_2-e.

Figure 4: Indirect Greenhouse Gas Emissions from the Generation of Purchased Electricity Trends by Economic Sector, 1990 to 2017



Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

Note: Scope 2 emissions account for greenhouse gas emissions from the generation of purchased electricity. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity (*NGA Factors 2017*). Emissions from electricity generation consumed within the *electricity, gas and water* sector are included in the above graph for completeness although this electricity use includes own use of generators and does not necessarily meet the NGA Factors 2017 definition of scope 2 emissions.

Table 6: Australia's Indirect Emissions from the Generation of Purchased Electricity (Scope2 Emissions), 1990, 2016 and 2017[(a)][(b)]

		Emissions (Mt CO_2-e)		
ANZSIC code	Industry Classification	1990	2016	2017
Div A	Agriculture, forestry and fishing	1.6	1.3	1.6
Div B	Mining	7.7	23.6	18.9
Div C	Manufacturing	42.3	44.2	48.9
Div E-H, J-Q	Commercial services and construction	23.0	50.9	47.2
Div I	Transport and storage	1.6	4.8	3.5
–	Residential	33.9	45.0	45.9

Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

Scope 2 emissions account for greenhouse gas emissions from the generation of purchased electricity. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity (*NGA Factors 2017*).
(a) The estimate of scope 2 emissions from electricity generation consumed within the *electricity, gas and water* sector includes own use of electricity by generators and is not necessarily purchased electricity. As these emissions do not necessarily meet the definition outlined at (a) they have been omitted from the table above. Electricity generation emissions attributed to the *electricity, gas and water* sector were approximately equal to 19.6 Mt CO_2-e in 1990, 25.0 Mt CO_2-e in 2016 and 23.8 Mt CO_2-e in 2017.

Table 7: State and Territory Emissions from the Generation of Purchased Electricity (Scope 2 Emissions), 1990[a][b]

ANZSIC code	Industry Classification	NSW[c]	VIC	QLD	WA
		Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e
Div A	Agriculture, forestry and fishing	0.5	0.5	0.3	0.2
Div B	Mining	1.6	0.9	2.1	2.6
Div C	Manufacturing	14.4	17.8	6.4	1.5
Div E-H, J-Q	Commercial services and construction	7.0	7.4	4.1	2.5
Div I	Transport and storage	0.7	0.4	0.6	0.0
	Residential	13.3	10.2	5.5	2.3

ANZSIC code	Industry Classification	SA	TAS	NT
		Mt CO_2-e	Mt CO_2-e	Mt CO_2-e
Div A	Agriculture, forestry and Fishing	0.1	0.0	0.0
Div B	Mining	0.2	0.0	0.2
Div C	Manufacturing	1.8	0.3	0.0
Div E-H, J-Q	Commercial services and construction	1.5	0.1	0.4
Div I	Transport and storage	0.0	0.0	0.0
	Residential	2.4	0.1	0.2

Source: Australian Greenhouse Emissions Information System: http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

(a) Scope 2 emissions account for greenhouse gas emissions from the generation of purchased electricity. Purchased electricity is definedas electricity that is purchased or otherwise brought into the organisational boundary of the entity (*NGA Factors 2017*).

(b) The estimate of scope 2 emissions from electricity generation consumed within the *electricity, gas and water* sector includes own use of electricity by generators and is not necessarily purchased electricity. As these emissions do not necessarily meet the definition outlined at (b) they have been omitted from the table above. Electricity generation emissions attributed to the *electricity, gas and water* sector were approximately equal to 6.3 Mt CO_2-e in NSW, 6.7 Mt CO_2-e in VIC, 3.9 Mt CO_2-e in QLD, 1.4 Mt CO_2-e in WA, 1.1 Mt CO_2-e in SA, 0.05 Mt CO_2-e in TAS and 0.1 Mt CO_2-e in NT.

(c) The NSW inventory includes ACT emissions from the *stationary energy* sector.

Table 8: State and Territory Emissions from the Generation of Purchased Electricity (Scope 2 Emissions), 2017 [a][b]

ANZSIC code	Industry Classification	NSW[c]	VIC	QLD	WA
		Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e
Div A	Agriculture, forestry and fishing	0.5	0.5	0.3	0.2
Div B	Mining	3.5	0.6	4.6	8.9
Div C	Manufacturing	14.2	13.4	14.0	5.3
Div E-H, J-Q	Commercial services and construction	14.9	14.3	11.2	3.9
Div I	Transport and storage	1.0	0.8	1.1	0.5
	Residential	18.1	10.2	10.5	4.1

ANZSIC code	Industry Classification	SA	TAS	NT
		Mt CO_2-e	Mt CO_2-e	Mt CO_2-e
Div A	Agriculture, forestry and Fishing	0.1	0.0	0.0
Div B	Mining	0.7	0.1	0.4
Div C	Manufacturing	1.1	1.0	0.0
Div E-H, J-Q	Commercial services and construction	1.7	0.3	0.9
Div I	Transport and storage	0.0	0.0	0.0
	Residential	2.2	0.4	0.3

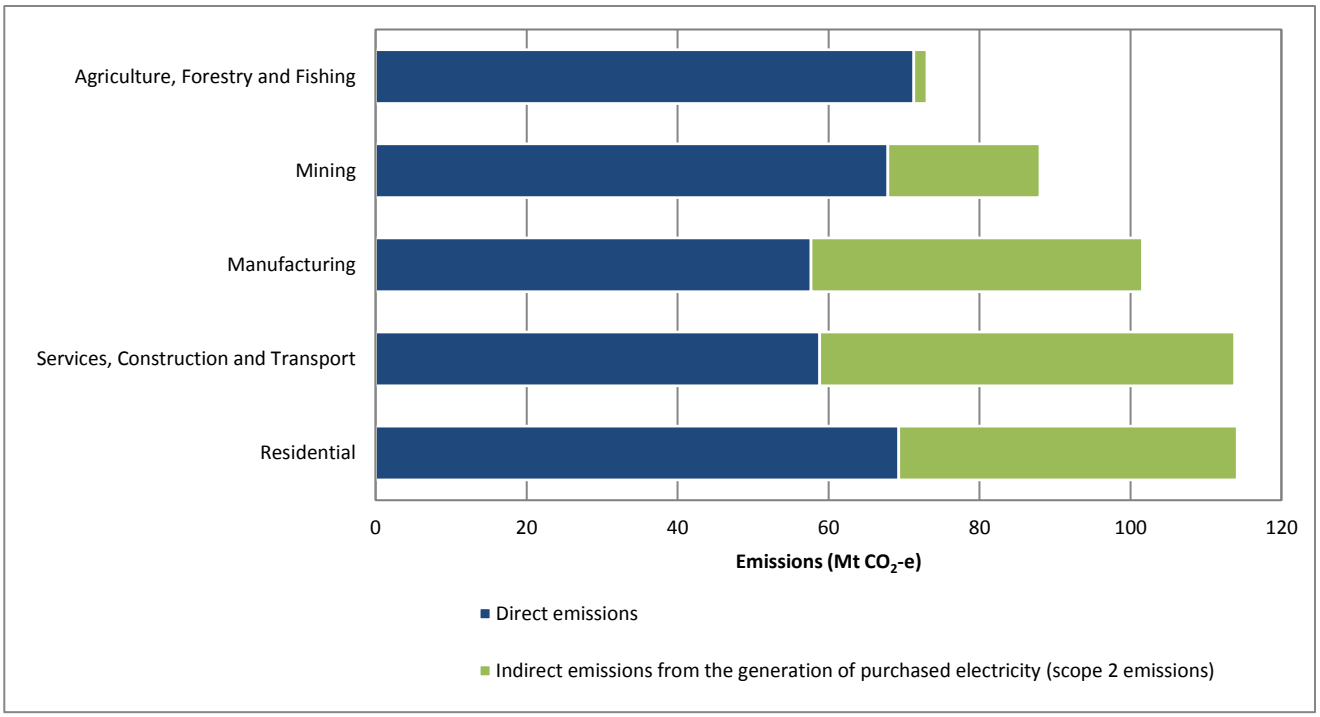
Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

(a) Scope 2 emissions account for greenhouse gas emissions from the generation of purchased electricity. Purchased electricity is definedas electricity that is purchased or otherwise brought into the organisational boundary of the entity (*NGA Factors 2017*).
(b) The estimate of scope 2 emissions from electricity generation consumed within the *electricity, gas and water* sector includes own use of electricity by generators and is not necessarily purchased electricity. As these emissions do not necessarily meet the definition outlined at (b) they have been omitted from the table above. Electricity generation emissions attributed to the *electricity, gas and water* sector were approximately equal to 6.1 Mt CO_2-e in NSW, 7.5 Mt CO_2-e in VIC, 6.6 Mt CO_2-e in QLD, 2.3 Mt CO_2-e in WA, 1.0 Mt CO_2-e in SA, 0.1 Mt CO_2-e in TAS and 0.2 Mt CO_2-e in NT.
(c) The NSW inventory includes ACT emissions from the *stationary energy* sector.

PART C – Combined Direct Emissions and Indirect Emissions from the Generation of Purchased Electricity

In this part of the report, the direct and scope 2 emissions have been combined to provide a broader understanding of the emissions resulting across the economy, from activity within each economic sector. The direct emissions associated with electricity generation have been removed to avoid double counting as they are already embodied within the indirect (scope 2) emissions from purchased electricity. Caution should be taken when analysing combined emissions due to the different conceptual bases of the emission estimate components. Direct emissions are allocated to individual sectors at the point of emissions while indirect emissions from the generation of purchased electricity (scope 2 emissions) are not produced within the bounds of the industry to which they are attributed.

Figure 5: Australia's Combined Direct and Indirect Greenhouse Gas Emissions from the Generation of Purchased Electricity (Scope 2 Emissions) by Major Economic Sector, 2017

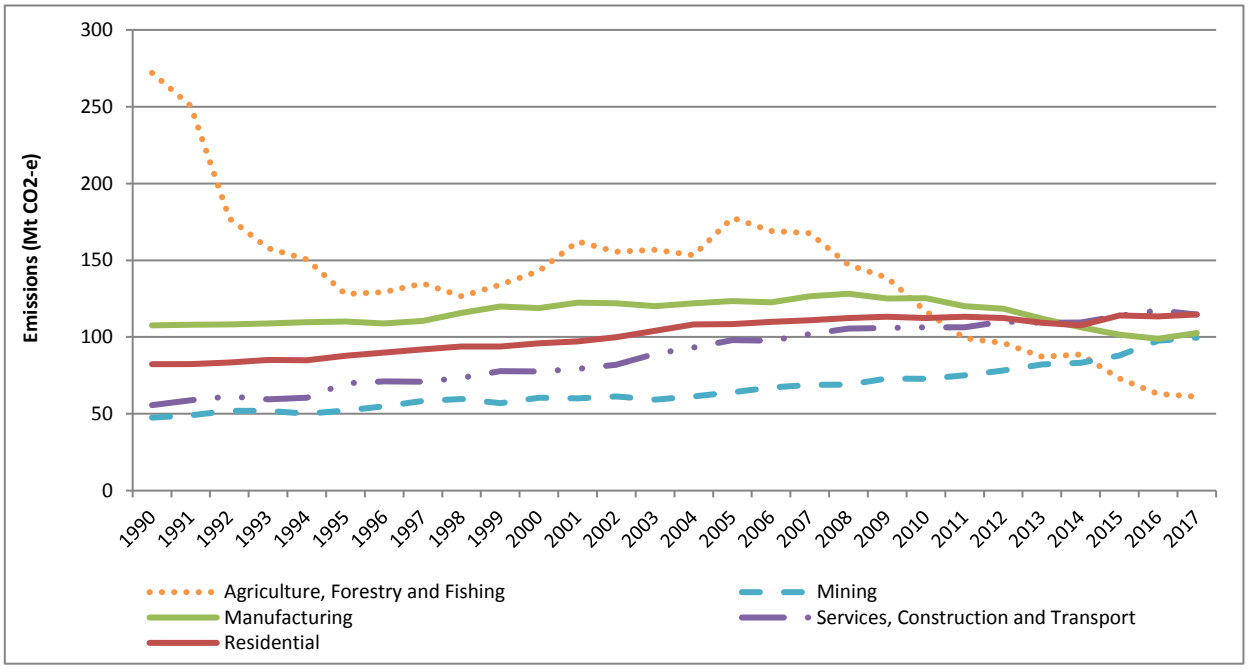


Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

Note: Scope 2 emissions account for greenhouse gas emissions from the generation of purchased electricity.

Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity (*NGA Factors 2017*). Emissions from electricity generation consumed within the *electricity, gas and water* sector are not included in the figure above as this electricity use includes own use of generators and does not necessarily meet the *NGA Factors 2017* definition of scope 2 emissions.

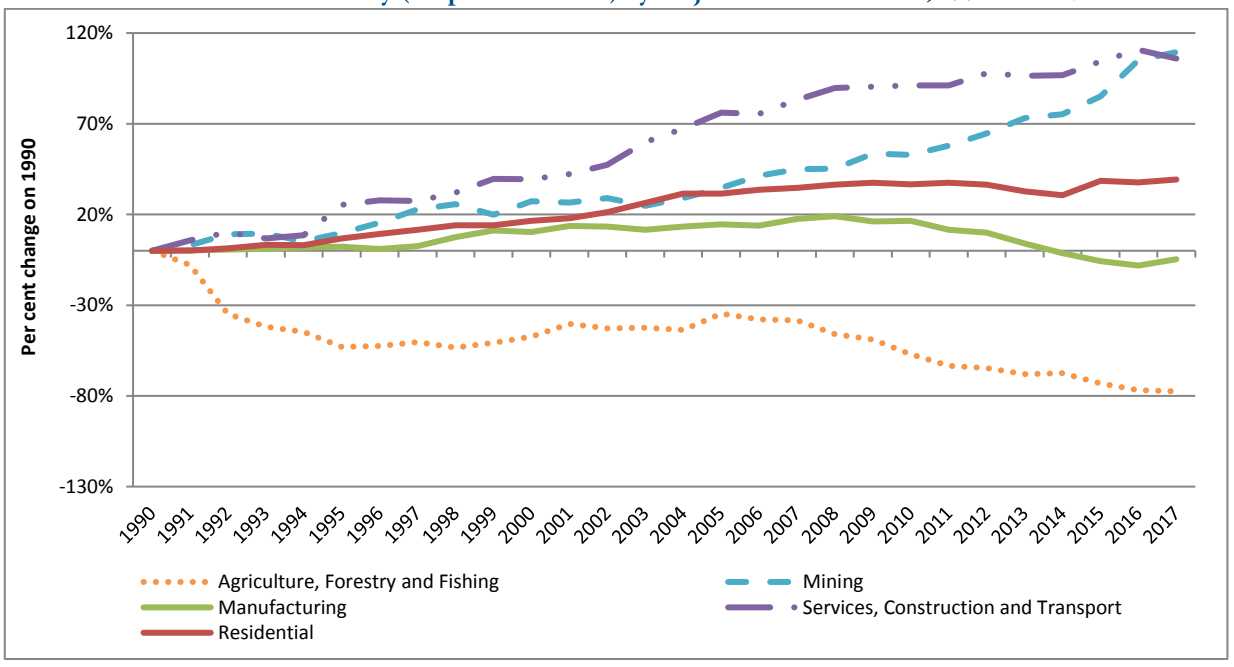
Figure 6: Combined Direct and Indirect Greenhouse Gas Emissions from the Generation of Purchased Electricity (Scope 2 Emissions) by Major Economic Sectors, 1990 to 2017



Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

Note: Direct emissions and indirect greenhouse gas emissions from the generation of purchased electricity (scope 2 emissions) have been combined in the figure above to provide a broader understanding of the emissions resulting across the economy from activity within each economic sector. Caution should be taken when analysing combined emissions due to the different conceptual bases of the emission estimates.

Figure 7: Percentage Change in Combined Direct and Indirect Greenhouse Gas Emissions from the Generation of Purchased Electricity (Scope 2 Emissions) by Major Economic Sectors, 1990 to 2017



Source: Australian Greenhouse Emissions Information System:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

Note: Direct emissions and indirect greenhouse gas emissions from the generation of purchased electricity (scope 2 emissions) have been combined in the figure above to provide a broader understanding of the emissions resulting across the economy from activity within each economic sector. Caution should be taken when analysing combined emissions due to the different conceptual bases of the emission estimates.

Appendix 1 – Notes

Australian National Greenhouse Accounts

Australia's National Greenhouse Accounts are comprised of the:

- *Quarterly Update of Australia's National Greenhouse Gas Inventory ;*
- *State and Territory Greenhouse Gas Inventories,*
- *National Inventory by Economic Sector; and*
- *National Inventory Report* prepared under the reporting provisions applicable to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (KP).

These publications are available online:
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/tracking-emissions

The emission estimates for these inventories are prepared in accordance with international guidelines and are subject to annual review by international experts. The methodologies for the estimation of emissions are documented in Australia's National Inventory Report.

Update of the ANZSIC reporting Framework

The ANZSIC hierarchy used to prepare the National Inventory by Economic Sector has been updated for this release. Industry allocations have been updated to align with the Australian and New Zealand Standard Industrial Classification 2006 (ABS cat no. 1292.0). Waste sector emissions are now allocated to ANZSIC Division D – Electricity, Gas, Water and Waste Services, and LULUCF sector emissions have been given a more detailed allocation beyond Division A – Agriculture, Forestry and Fishing.

The allocation of transport fuels between industries has been revised to account for information published in the Australian Energy Account (ABS cat no. 4604.0).

The allocation of refrigeration and air-conditioning emissions has also been refined to better reflect consumption of refrigerants in the Australian economy.

For disaggregated emissions estimates, refer to the AGEIS (http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis).

Kyoto Accounting

'Kyoto accounting' is relevant to Australia's target under the second commitment period (CP2) of the Kyoto Protocol (KP), which is yet to enter into force. This report covers 2017, the fifth year of CP2.

Under the Kyoto Protocol, the national inventory must report net emissions from the *energy, industrial processes and product use, agriculture,* and *waste* sectors. The inventory must also include the mandatory Land Use, Land Use Change and Forestry (LULUCF) activities of *afforestation/reforestation*, *deforestation*, and *forest management*. In addition to these, the voluntary LULUCF activities of *cropland management* and *grazing land management* have also been included in Australia's national inventory for CP2.

The *energy* sector is made up of many different sources, including:

Stationary energy is mainly greenhouse gas emissions from the production of electricity and other direct

combustion of fossil fuels in industries such as manufacturing and construction.

Transport comprises greenhouse gas emissions from air, road, rail and shipping transportation.

Fugitive emissions comprises the greenhouse gas emissions from the extraction and distribution of coal, oil and natural gas.

The *Industrial processes and product use* sector comprises the direct greenhouse gas emissions from the chemical and or physical transformation of materials and the consumption of synthetic greenhouse gases.

The *Agriculture* sector comprises the emissions of methane and nitrous oxide only (that is, non-carbon dioxide gases) from livestock, crops, and agricultural and forest soils.

The *Waste* sector comprises the greenhouse gas emissions from the disposal of solid waste to land, the treatment of domestic and industrial wastewater, the incineration of municipal and clinical waste and the biological treatment of solid waste.

The LULUCF sector is made up of several sources, including:

Deforestation comprises emissions and removals from the direct human-induced conversion of forest to alternative land uses since 1 January 1990.

Afforestation/reforestation comprises emissions and removals (that is sinks) from forests established since 1990 on land that was clear of forest on 31 December 1989. Forests may be established by planting events for commercial timber or for other reasons, known as 'environmental plantings', or by regeneration from natural seed sources on lands regulated for the protection of forests.

Forest management comprises emissions and removals from those forests managed under a system of practices designed to support commercial timber production such as harvest or silvicultural practices or practices designed to implement specific sink enhancement activities. This includes multiple-use public forests; plantations established prior to 1990; and privately managed forest land where defined harvest, silvicultural and sink enhancement activities have been observed to occur.

Cropland management comprises emissions and removals from land that is used for continuous cropping, lands managed as crop-pasture rotations and forest land converted to cropland prior to 1990. Perennial crops including orchards and vineyards are included under cropland management.

Grazing land management comprises emissions and removals from lands including grasslands, forests in northern Australia monitored for 'savanna burning' and forests established by regeneration from natural seed sources on lands not regulated for the protection of forests (and which are not classified as afforestation/reforestation).

Revegetation includes the establishment of vegetation that covers a minimum area of 0.05 hectares and does not meet the definitions of *afforestation/reforestation.* The activity is restricted to settlements and wetlands.

The 1990 estimate presented here for LULUCF, is the 'base year' estimate used for the initial estimate of Australia's CP2 assigned amount or carbon budget.

Australian Greenhouse Emissions Information System

The Australian Greenhouse Emissions Information System (AGEIS) provides on-line public access to emission estimates, background supporting data and time-series analyses that support the National Greenhouse Accounts. The dynamic interface allows users to select emissions data of interest and download the results in a format which allows for further analysis of the data on their own desktop. The AGEIS can be accessed online: http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

Gases

This report covers sources of greenhouse gas emissions and removals by sinks resulting from human (anthropogenic) activities for the major greenhouse gases – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6). In accordance with IPCC guidelines, Australia's emissions of the greenhouse gas nitrogen trifluoride (NF_3) are considered negligible and are not estimated.

Global warming potentials have been used for each of the major greenhouse gases to convert them to carbon dioxide equivalents (CO_2-e). As greenhouse gases vary in their radiative activity and in their atmospheric residence time, converting emissions into CO_2-e allows the integrated effect of emissions of the various gases to be compared. The GWPs used in this Report were the 100-year GWPs contained in the 2007 IPCC *Fourth Assessment Report* (IPCC 2007), by international agreement.

External Territories

The geographical coverage of the State and Territories Greenhouse Gas Inventories also includes emissions from Norfolk Island, Christmas Island, Cocos (Keeling) Islands, and Heard and McDonald Islands. Australia's Antarctic Program operations in the Antarctic are also covered. The following external territories are covered but are included in the respective state statistical territories by the Australian Bureau of Statistics: Coral Sea Islands (Queensland), and Ashmore and Cartier Islands (Northern Territory).

Uncertainty Analysis

Uncertainty is inherent within any kind of estimation. Uncertainty assessments at a sectoral level are reported in the National Inventory Report. Overall, at the national inventory level including LULUCF, the uncertainty of the emissions estimates level has been assessed at 6.5 per cent. While no quantitative estimates have been produced, the Department assesses that the uncertainties for emission estimates for these inventories, particularly the smaller States and Territories, will be somewhat higher than for the national inventory.

Recalculations

Recalculations in the Economic sector inventory have occurred mainly as a result of the move to the 2006 ANZSIC system and the associated re-allocation of emissions within ANZSIC divisions. Other sources of recalculations relate to those undertaken in the National Inventory submission 2017.

The impact of the recalculations on emission levels for Economic sectors was a decrease in the estimate of total emissions for the year 2016 of 3.0 Mt or 0.6 per cent. The largest recalculation is in *Div. D Electricity, Gas and Water Supply*, with an increase for the year 2016 of 8.5 Mt or 4.2 per cent, reflecting the reallocation of waste collection treatment and disposal services to Division D. Other significant downward recalculations have occurred in Division B *Mining* (8.4 Mt or 10.2 per cent) and Division C *Manufacturing* (5.3 Mt or 8.8 per cent). These decreases mainly relate to reallocation of transport emissions from these sectors to the residential sector which has experienced a 7.6 Mt or 12.5 per cent recalculation.

Further information on recalculations is provided in Chapter 10 of Volume 2 of the National Inventory Report 2017 (May 2019).

Table 9: Estimated recalculations for this submission (compared with last year's publication), 2016

	Mt CO_2-e			
Sector	**2016 publication**	**2017 publication**	**Recalculation**	**Per cent Recalculation**
Total of all Economic (ANZSIC) Sectors	533.0	529.9	-3.0	-0.6
Div. A Agriculture, Forestry and Fishing	64.3	61.6	-2.7	-4.2
Div. B Mining	82.3	73.9	-8.4	-10.2

Div. C Manufacturing	60.0	54.7	-5.3	-8.8
Div. D Electricity, Gas and Water Supply	201.2	209.7	8.5	4.2
Div. E Construction	9.4	8.4	-1.1	-11.2
Div. F-H, J-Q Commercial Services	25.4	22.2	-3.2	-12.5
Div. I Transport, Postal and Warehousing	29.4	31.0	1.6	5.4
Residential	60.9	68.4	7.6	12.5

Related Publications and Resources

Australia's National Greenhouse Accounts

The following Department of the Environment and Energy and Energy publications are all available on the departmental website.

National Inventory Report 2017

The three volumes comprising *Australia's National Inventory Report 2017* have been submitted under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol in May 2019. These reports contain national greenhouse gas emission estimates for the period 1990-2017 compiled under the rules for reporting applicable to the UNFCCC.

Volume 1: Includes Australia's data for *energy* (*stationary energy, transport* and *fugitive emissions*), *industrial processes* and *agriculture*.

Volume 2: Australia's data for the *Land Use, Land Use Change and Forestry* (LULUCF) and *waste* sectors, recalculations and improvements.

Volume 3: Australia's data for Kyoto Protocol LULUCF, Kyoto Protocol accounting requirements, annexes, glossary and references.
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/progress-inventory

State and Territory Greenhouse Gas Inventory 2017

This document provides an overview of the latest available estimates of annual greenhouse gas emissions for Australia's States and Territories. It complements Australia's National Inventory Report 2017.

Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2018

This report provides estimates of Australia's national inventory up to the December quarter of 2018.

Emissions Projections: Australia's emissions projections 2018

The report provides detail on emissions trends, including sector specific analysis of factors driving emissions. It also includes sensitivity analyses taking into consideration different assumptions of technology change and energy exports in the future:
http://www.environment.gov.au/climate-change/publications/emissions-projections-2018

Australian Greenhouse Emissions Information System (AGEIS)

The AGEIS centralises the Department's emissions estimation, emissions data management and reporting systems. AGEIS is being used to compile national and state and territory inventories. The interactive web interface provides enhanced accessibility and transparency to Australia's greenhouse emissions data.
http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/ageis

Full Carbon Accounting Model

The Full Carbon Accounting Model (FullCAM) is the calculation engine which supports the estimation of carbon stock change on forest and agricultural systems. FullCAM can be downloaded from the Department's webpage: http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/land-sector.

Australia's Second Biennial Report

Australia's second Biennial Report is a comprehensive summary of Australia's progress towards meeting its commitments under the United National Framework Convention on Climate Change (UNFCCC). Countries such as Australia are required to submit these reports to the UNFCCC every two years.
http://www.environment.gov.au/climate-change/publications/australias-second-biennial-report

What the rest of the world is doing

Other developed countries are also required to produce annual greenhouse gas inventories. More information regarding the reporting requirements and various international reports (including reports by Australia) are located online: http://unfccc.int/national_reports/items/1408.php

environment.gov.au

CC145.0317